

Interactive comment on “Ozone photochemistry in boreal biomass burning plumes” by M. Parrington et al.

Anonymous Referee #1

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Parrington et al. present measurements of ozone and ozone precursors made on-board the UK BAe-146 research aircraft as part of the summer 2011 BORTAS-B project. The measurements presented are analysed in order to assess the photochemistry of ozone occurring in boreal biomass burning plumes. Whilst this is not a novel subject, the presentation and analyses of these results clearly falls within the scope of ACP and the manuscript is well written and provides interesting results. However, the paper is in need of reduction in places and the analysis is in need of extension in others. I suggest several minor revisions are required before it is suitable to be published in ACP.

General comments: Is this a paper whose purpose is to act as a reference to document the observed ozone and ozone precursors or is this to be the major paper analysing

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ozone photochemistry as part of the BORTAS special issue? If it is the latter then I am surprised that no modelling work has been performed or at least references made to link this work with future planned analysis studies. After highlighting several possible complicating factors in the analysis (e.g. heterogeneous chemistry) the paper concludes with “Numerical models of atmospheric chemistry and transport can be used to investigate these factors, their influence on ozone production in boreal biomass burning plumes and its subsequent impact on tropospheric oxidant chemistry”. Indeed many other studies have done such (e.g. Cook et al., 2007). So I find it surprising that there is no reference to plans to analyse this work further or no use of model simulations for instance to help understand why the calculated ozone production efficiency (OPE) is so high for the case when RH measurements were low.

Section 3 really makes for dull reading. At the moment it reads very much like a diary. For a start a figure of the flight tracks might help to orientate the reader, but I would encourage the authors to investigate ways of reducing the text.

Specific comments:

Abstract: The authors need to include the associated uncertainties that they calculate for the OPE's relative to Sum(AlkylNitrates) and NO₂.

Page 1798 line 9: Add “of” after “production”. Page 1798 line 21-27: This reads clumsily. Please rephrase. Page 1803 line 3: What do the subscript ‘i’s refer to? Page 1804 line 21: Update Di Carlo reference to AMT paper (also update reference section). Page 1809 line 18-21: Rephrase. Page 1809 line 24: Does the green square reflect one photochemical age? Figure 7a shows that there was a range of ages for this B626 data. How does this impact further calculations? Page 1810 line 15: Please briefly justify the use of 273 K. Page 1810 line 27: Why not take [OH] to be 1E6 cm⁻³? Or 1.5E6 cm⁻³? How would that effect the results? I think that by re-performing this analysis using a range of estimates of [OH] would be beneficial to the reader. Given that [OH] was not measured directly it would be useful to calculate the ages given a range

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of possible [OH] (one could even get this range from a model?). Page 1812 line 14 and 21: replace "Fig. 5X" with "Fig. 7X". Page 1817 line 19: Can the authors clarify if $\Delta X = [X]_{\text{inplume}} - [X]_{\text{background}}$? Page 1818 line 23-25: So does this give some indication of plume heights? What are the typical heights of plumes based on MISER data or model data? Page 1819 line 10: Add missing power of 10? I presume the authors don't mean 1.4^{12} ? Page 1819 line 25: Doesn't JNO₂ go to 0.0 at night? Page 1821 line 10: Is this significant? It is mentioned that this is similar to ground based data. HO_xRO_x is a nice diagnostic but what information can be learned from it about the underlying RO₂ chemistry occurring in plumes? I think some reference to modelled values of HO_xRO_x would be useful especially if they can help identify if there is "interesting" chemistry going on, what the mix of RO₂ is etc. Page 1824 line 23: Add "that" after "processes".

References:

Cook, Peter A., et al. "Forest fire plumes over the North Atlantic: p-TOMCAT model simulations with aircraft and satellite measurements from the ITOP/ICARTT campaign." *Journal of geophysical research* 112.D10 (2007): D10S43.

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